



Copper Water Pollution from Vehicle Air Emissions

*Science and Solutions from the
Brake Pad Partnership*

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Funding

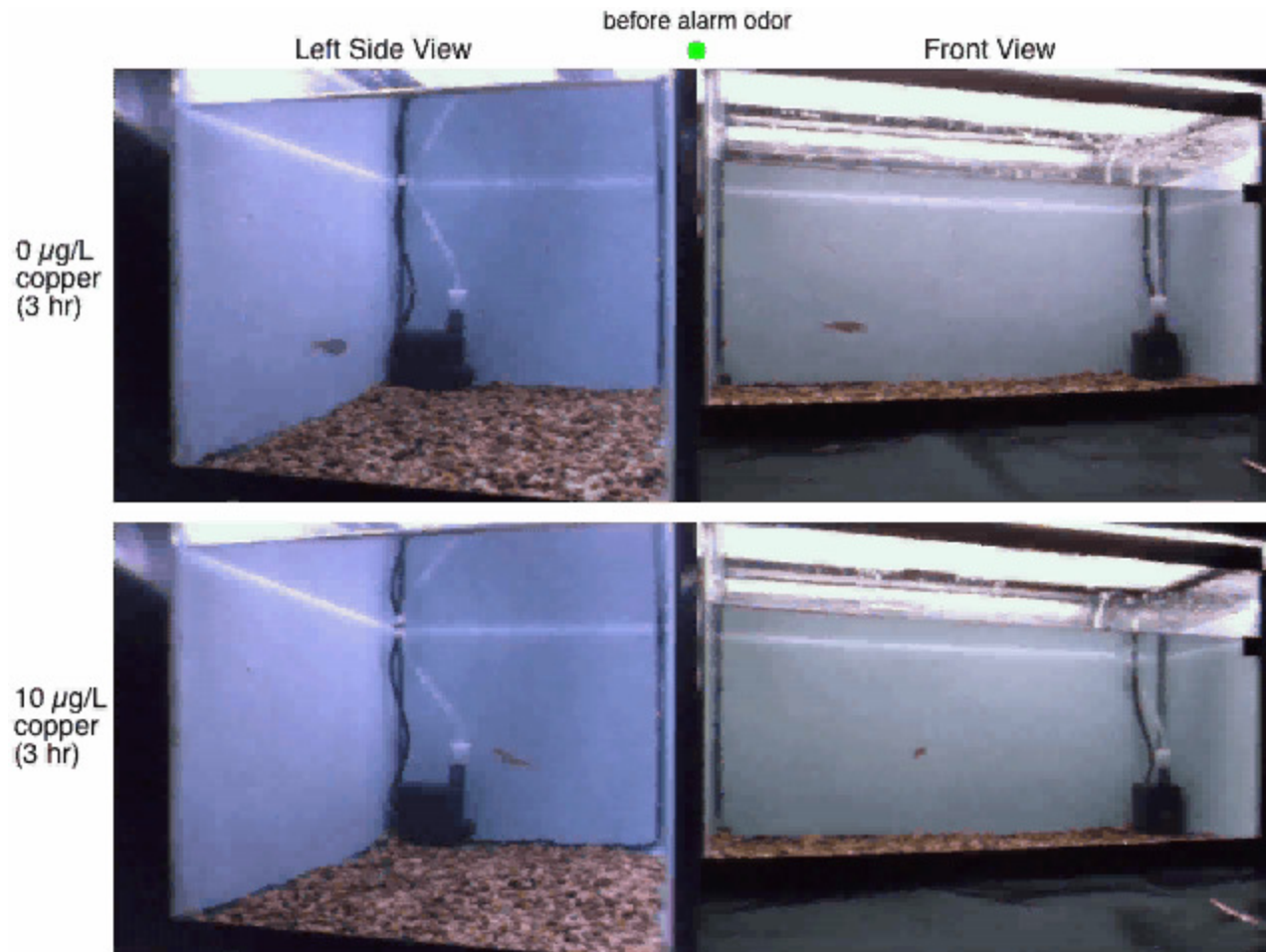
- State Water Board Proposition 13 grant
- California Municipalities
- Caltrans
- U.S. EPA
- Brake Manufacturers' Council
- Many others, including companies & foundations



Data Sources

- Studies funded by the Brake Pad Partnership
 - Available online: www.suscon.org/brakepad
- Publications in Brake Pad Partnership Technical Reference Library
 - Bibliographies w/abstracts on the BPP web site
- Studies funded by the SF Bay Clean Estuary Partnership
 - Available online: <http://www.cleanestuary.org/publications/>
- Recent scientific publications
 - For example, recent article in journals like *Environmental Science & Technology*

Copper – A Common Urban Water Quality Problem



Source: Sandahl, J. F.; Baldwin, D. H.; Jenkins, J. J.; Scholz, N. L., A Sensory System at the Interface between Urban Stormwater Runoff and Salmon Survival. Environ. Sci. Technol. 2007, 41, (8), 2998-3004. Supporting Information.



Copper Air Emissions from Brakes Contribute to Water Quality Problems

- Brake pads are estimated to be the largest source of copper releases in highly urbanized watersheds
- Total copper use in original equipment brake pads has doubled since 1998
 - New safety standard created design challenge
- Copper emitted from brake pads readily dissolves in environmental solutions
 - Common treatment devices don't effectively remove copper from urban runoff



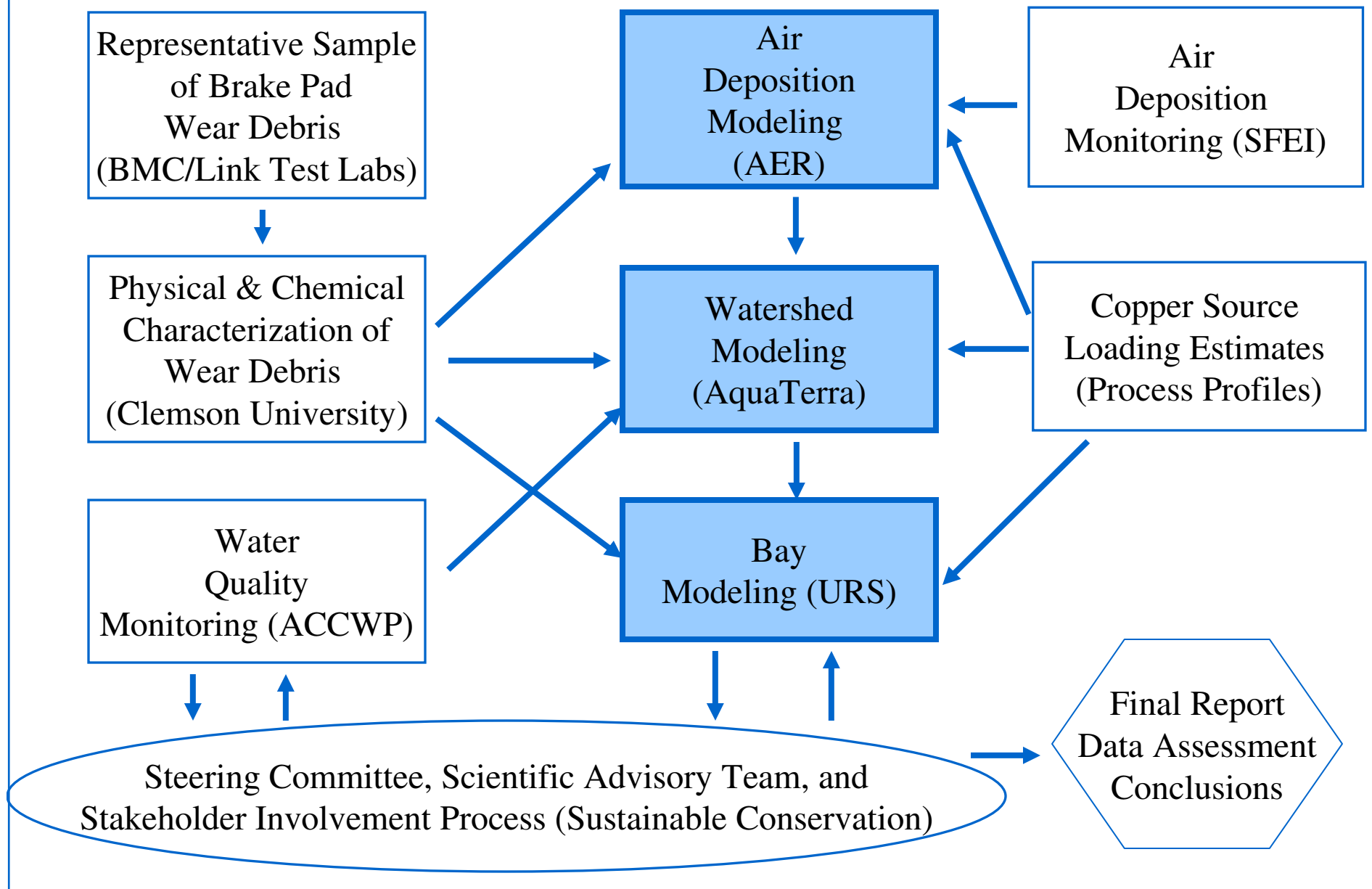




Brake Pad Partnership

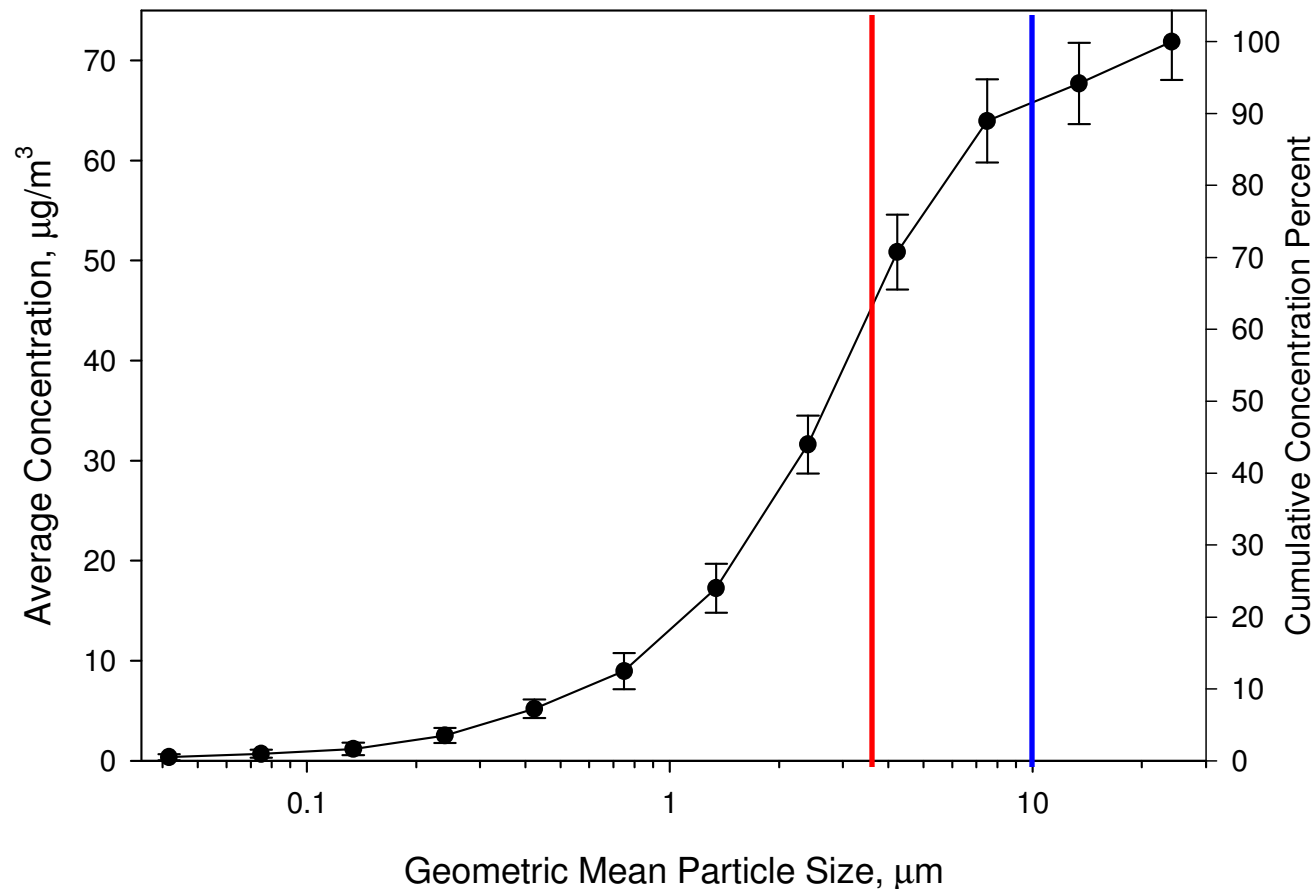
- Voluntary Partnership
- Multi-stakeholder
 - Manufacturers, Government, Environmental groups
 - Neutral facilitator (Sustainable Conservation)
- Formed to address the impacts of material released from use of vehicle brakes on surface waters
- Research done by contractors & universities
- Cooperative approach gives stakeholders confidence in results

Brake Pad Partnership Technical Studies



Mean Brake Pad Wear Debris Airborne Particle Size $< 3\mu\text{m}$

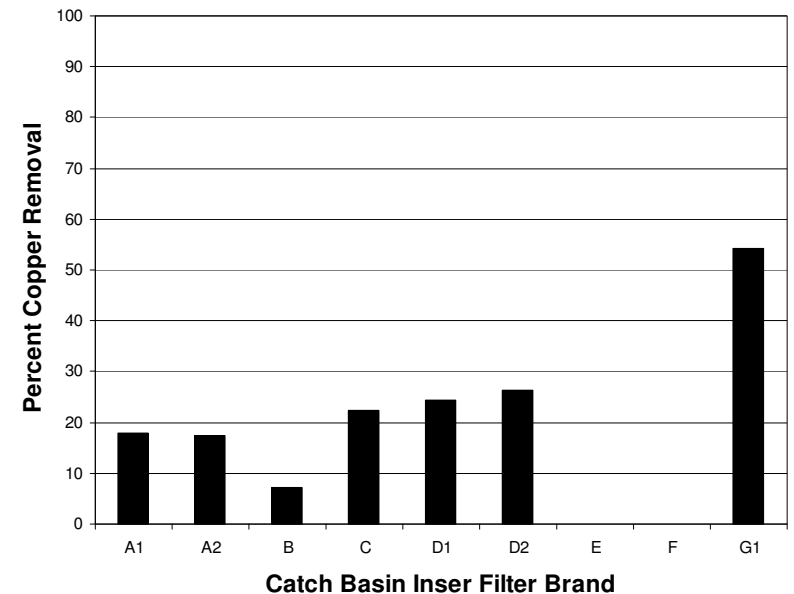
Theoretical Composite Cumulative Concentration-Based
Particle Size Distribution after Blank Adjustment



Because copper is generally dissolved or in fine particulates in runoff, mechanical treatment systems are relatively ineffective at copper removal. Vegetative systems are more effective, but efficiency is still not high.

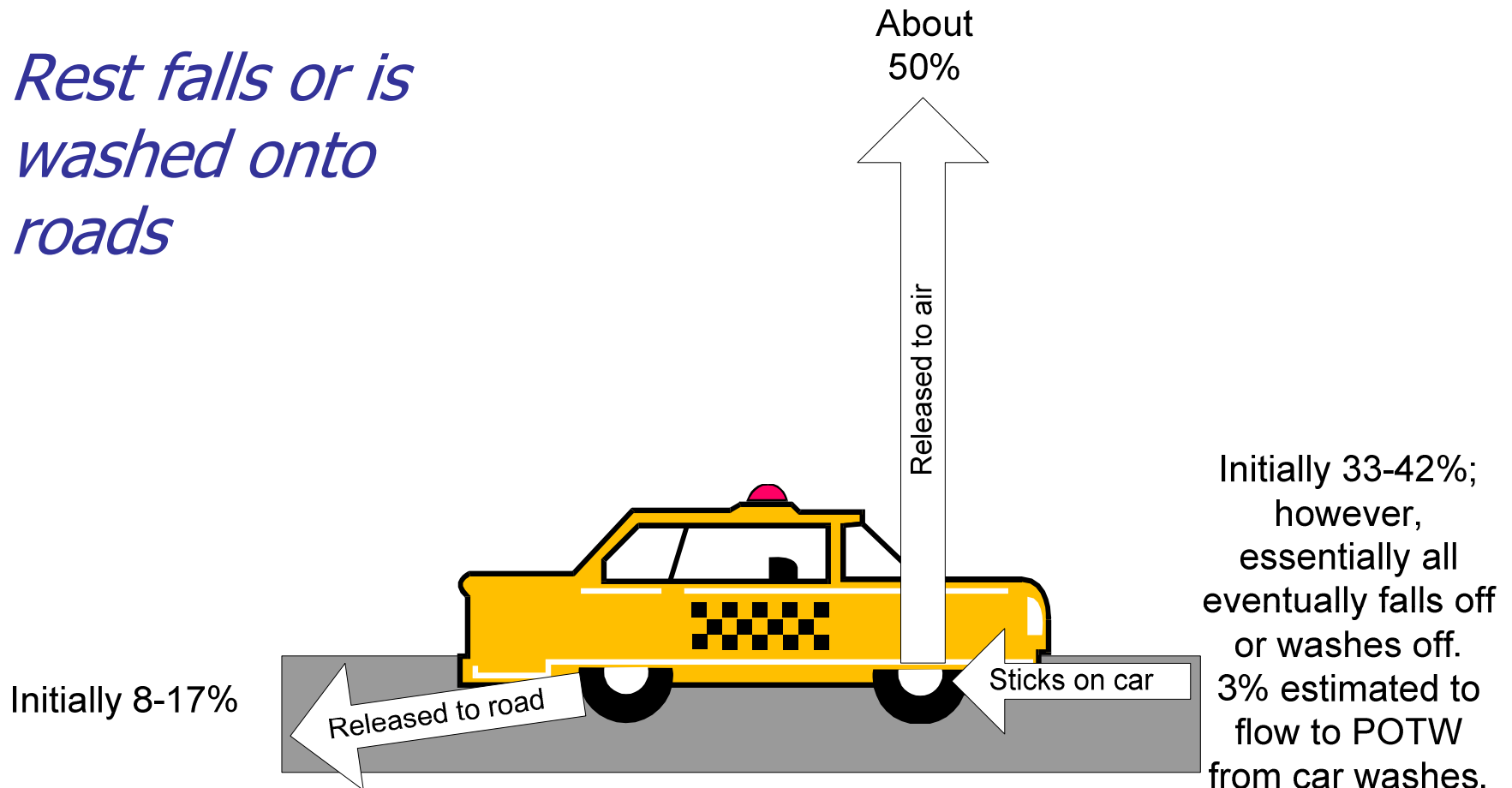
Catch Basin Insert Filter Copper Removal Low

Figure adapted from Hipp et al, ES&T, 2006



About half of brake pad wear debris is released initially to air

Rest falls or is washed onto roads





BPP Air Deposition Key Findings

- Brake pads a main copper deposition source
 - Copper air deposition \approx deposition from brake pads + site-specific industrial emissions + re-suspension of soils
 - “Background” deposition relatively small
- More braking on city streets than highways
 - Modeling & limited mfr. data suggest about 5X less emissions from freeways per vehicle mile traveled (VMT)
- Widespread deposition occurring
- Important local effects
 - Deposition & rain washoff on roads
 - Resuspension to nearby area
 - “Spew” fallout near roads

Urban Runoff Copper Sources & Controls

Source Estimates from Highly Urbanized SF Bay Area Watersheds
Controls from Clean Estuary Partnership

Copper Source	Estimated Contribution	Most Feasible Controls
Vehicle brake pads	51-63%	Source Control
Architectural copper	3-13%	Source Control
Pool, spa & fountain algaecides	7-10%	Source Control
Industrial copper use (NOI facility runoff)	1-7%	Already being controlled
Landscape pesticides	3-29%	Options limited (harmful alternatives)
Other sources (Domestic water discharges, treated wood, fertilizers)	3-4%	Not much more possible
Soil erosion	*	Already being controlled
Copper-using industry with outdoor emissions	0%	Not significant in SF Bay Area

*Depends on copper content, slope & other site specific factors estimated in a manner not consistent with the other values in this table.

Source: Percentages from Brake Pad Partnership (2008). "Anthropogenic Sources of Copper in Wash-Off in the San Francisco Bay Area Sub-Watersheds." Data summarized for four highly urbanized SF Bay Area watersheds. Control strategies from Clean Estuary Partnership (2006). *Copper Management Strategy Development Resources*.



Solutions

New Approaches are Required

Statewide Action is Necessary



Traditional Water Quality Regulation Cannot Solve Copper Problem

- Clean Water Act traditional structure requires municipalities to solve pollution problems—BUT
 - Municipalities don't have authority to regulate brake pads
 - Treatment technically infeasible
- Alternative approaches are feasible
 - Industry Source - Regional – Air Permits
 - Products - State – Legislation or Air Board



Consumer Products Are Challenging to Control

- Local regulation impossible
- “Source control” much more cost effective than treatment
- No market mechanism to reflect water pollution cost
- No labeling required
 - Water pollutant content usually unknown
- Market forces often undercut voluntary programs



Holistic Approaches Promising

- SF Bay Water Board Water Quality Attainment Strategies (copper, pesticides)
 - Identify pollutant sources & implementation measures
 - Recognize role of state in solving problems



Brake Pad Partnership 2009 Legislation

- Topics to be addressed
 - Allowable amount of copper
 - Schedule for reductions
 - Compliance with near-term TMDLs is a challenge
 - Compliance/enforcement
 - Special exemptions
 - Substances other than copper
- Develop stakeholder support team
 - Interested agencies—provide contact information to Rich Watson 949-855-6272 rwatson@rwaplanning.com



Want more information?

Brake Pad Partnership (BPP)

www.suscon.org/brakepad/

- Project background/contacts
- Completed reports
- Technical Reference Library
- E-mail list

CASQA Members - BPP team

- Rich Watson 949-855-6272
rwatson@rwaplanning.com